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Art. XVIII.—*The Austral Rhynchonellacea of the "Nigricans Series," with a special description of the new Genus Tegulorhynchia.*

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(With Plates XI-XIII.)

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Contents.

I.—Introductory.

Since the phylogenetic relationships of the Cainozoic rhynchonellids belonging to the "*Hemithyris nigricans* series" of Buckman[1], of the Australasian (Southern Victoria and New Zealand) and other con-

1. Buckman, 1910, p. 13.

tiguous areas of the southern hemisphere do not seem to have been satisfactorily defined, the opportunity is now taken, with the help of a great deal of new material, to review the evidence already published. This, we hope to show, will prove that the southern stock of these multiplicate Cainozoic and Recent forms is generically distinct from *Hemithyris*, and seems to have been derived from a common Mesozoic type long before the period of the disintegration of the early Antarctic continent.

Until 1910, the Australian rhynchonellids, both fossil and recent, were referred to the genus *Rhynchonella* in the unrestricted sense. In that year, Mr. S. S. Buckman published a paper on Antarctic Fossil Brachiopoda[2], in which he described several fossil forms of rhynchonellids, two of which had been previously recorded under the genus *Rhynchonella* (*R. squamosa*, Hutton, and *R. plicigera*, Ihering). These fossil forms Buckman referred to d'Orbigny's genus *Hemithyris*, which in the original description is stated to possess no dental plates.

In 1914, one of us[3] referred to Hutton's species, *squamosa*, as belonging to the genus *Acanthothyris* of d'Orbigny, on account of the tendency of this form to develop a spinose character along the costae. This spinose character is fundamental in d'Orbigny's Jurassic genus. The genotype of *Acanthothyris* is *A. spinosa*, Schlotheim sp. of the Inferior Oolite of England[4]; but, as we hope to show later, the northern Jurassic and the southern Cainozoic forms belong to different stocks, and therefore the spinose character is an example of convergence of form.

In his revision of the Fossil Brachiopoda, Prof. Chas. Schuchert[5] had included the living spinose form, *Rhynchonella doederleini* of Davidson[6], as a representative of the genus still living in Japanese Seas. From the present evidence this species seems related to the southern types, which fall into the new genus *Tegulorhynchia*.

In reviewing all the evidence given by previous authors, and in the light of a large amount of material recently collected from Victorian and other Australian deposits, we find the results necessitate the establishment of a new genus which will include forms of the *Rhynchonella squamosa* type, the distinctive characters of which are discussed in a later section.

II.—Cainozoic and recent Austral Rhynchonellids: With Critical Notes.

antipoda, Hemithyris, Thomson.

Thomson, 1918[2], p. 117.

> "In *H. antipoda*, the ribs are similar in size to *H. nigricans*, but rather more numerous, and are incipiently spinose."

2. Buckman, 1910, pp. 10-14.
3. Chapman, 1914, pp. 166, 167, fig. 89F.
4. cf. Davidson, 1852, p. 71, pl. xv., figs. 15-20.
5. Schuchert, in Zittel, 1913, p. 400.
6. Davidson, 1887, p. 172.

From specimens kindly lent us by Dr. Thomson from New Zealand, we note that the species *antipoda* differs from *thomsoni* in having a more salient beak and several strong, concentric growth-lines, especially seen on the dorsal valve.

Miocene.—Curiosity Shop, Rakaia River, Canterbury, N. Z.

australis, Hemithyris, Buckman.

Buckman, 1910, p. 12, pl. I., fig. 11.

This smooth, sub-pentagonal form is referred by Buckman to the *Rhynchonella bipartita* series. From its more erect form of beak and even growth-lines, it is possibly a distinct form from the boreal, living hemithyrids; although related forms are known from the Eocene and Miocene of Europe, and *R. lucida* is living in Japanese Seas. It belongs to the hypothyrid section, as pointed out by J. Allan Thompson[7], otherwise it is similar to Thomson's generic form, *Aetheia.*

Miocene.—Glauconitic Bank, Cockburn Island, Graham Land.

coelata, Rhynchonella, McCoy (in Tenison Woods).

Woods, J. E. T., 1878, p. 77.

Generally referred to as an Ms. name of McCoy's. T. Wood's gives a short description of the shell, which places beyond doubt its identity with our common Victorian form, (see *postea*).

"From several Miocene beds in Victoria," Miocene (Janjukian).

colurnus, Hemithyris, Hedley.

Hedley, 1905, p. 44, text-fig., 7, 8.

The nearest ally is *Hemithyris beecheri*, Dall, found in 313 fathoms at Honolulu. This is a triangular, cordate form, smooth, except for faint growth-lines. From the distinctly epithyrid foramen, this species appears to belong to Thomson's genus *Aetheia.*

Recent.—Dredged at 111 fathoms, East of Cape Byron, New South Wales.

depressa, Hemithyris, Thomson.

Thomson, 1918, p. 117.

A small species with short beak. "Possesses numerous fine ribs with imbrication towards the margin."

Miocene (Ototaran and Lower Hutchinsonian stages).—One mile north of Kakanui Quarry, Oamaru District.

doederleïni, Rhynchonella, Davidson.

Davidson, 1887, p. 172, pl. XXV., figs. 14, 15, text-fig. 19.

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7. Thomson, 1915, p. 390.

Appears to show some interesting annectant characters of the tubular-spined Miocene forms found in Australian deposits.

Recent.—Dredged, Sagami Bay, Japan, in about 160 fathoms.

gerlachei, Rhynchonella, Joubin.

Joubin, 1901, p. 7, pl. I., figs. 5-9; pl. II., fig. 10.

A suboval form with smooth shell, but for faint growth-lines. The beak is erect and deltidial plates are very narrow. It belongs to the *Rhynchonella bipartita* group.

Recent.—Antarctic Seas.

imbricata, Hemithyris, Buckman.

Buckman, 1910, p. 11, pl. I., fig. 12.

Apparently nearly related to some well preserved rhynchonellids from Table Cape, Tasmania, which we have named *Tegulorhynchia coelospina*.

Miocene.—Glauconitic Bank, Cockburn Island, Graham Land.

nigricans, Terebratula, Sowerby.

Sowerby, 1846, p. 342, pl. LXXI., figs. 81, 82.

(*Rhynchonella*). Suess, 1864, p. 60, pl. XIV., figs. 4*a-d* (expl. of plate 5*a-d* in error).

This living and fossils species is a modification of the *squamosa* type, in which the shell is more terebratelloid in form and the ornament less distinctly tegulate.

Miocene.—Oamaruian and Awamoan, New Zealand (Hutton).

Recent.—Coast of New Zealand, in 19 fathoms.

nigricans, var. *pyxidata*, Rhynchonella, Davidson,

Davidson, 1880, p. 59, pl. IV., fig. 14. Id., 1889, p. 171.

This form has been compared by Davidson (op. cit. 1880, p. 60), with McCoy's *R. coelata*, but which we consider distinct.

Recent.—Dredged south of Kerguelen Island, at 150 fathoms, rocky sea-bottom.

patagonica, Rhynchonella, Ihering.

Ihering, 1903, p. 334, pl. III., figs. 11*a*, *b*.

Figures given by Ihering are not very clear, especially as regards ornament, but that difficulty is removed by Ortmann's figure of *R. squamosa*, which is accepted by Ihering as identical with *R. patagonica*. In the description of *R. patagonica* by Ihering it is pointed out that the species differs from *R. squamosa*, Hutton (non Ortmann) in having a larger number of costal rays. We also note that Ortmann's specimen shows about 12 costæ on the sinus, and Ihering mentions 15.

Miocene.—Lake Pueyrredon (Ortmann). Rio Seco and San Julian (Ihering). Patagonia.

plicigera, Rhynchonella, Ihering.

Ihering, 1897, p. 270, text-fig. 7.

Id., 1903, p. 334.

Ortmann, 1901, p. 70, pl. XII., figs. 3*a-e*.

This species by its coarse plication, transverse shape and anterior tegulation, closely approaches our new species, *Tegulorhynchia thomsoni*.

Miocene (Lower, Middle and Upper Patagonian). Patagonia.

plicigera, Hemithyris, Buckman (non Ihering).

Buckman, 1910, p. 12, pl. I., fig. 10.

This species appears to differ from Ihering's *R. plicigera* on account of the narrow form of valves and character of ornament, which appears to be confined to the anterior margin.

Miocene.—Glauconitic Bank, Cockburn Island, Graham Land.

racovitae, Rhynchonella, Joubin.

Joubin, 1901, p. 5, pl. I., figs. 1-3.

A smooth, sub-pentagonal hypothyrid rhynchonellid, with only faintly sinuated anterior.

Recent.—Antarctic Seas.

squamosa, Rhynchonella, Hutton.

Hutton, 1873, p. 37.

A suborbicular, finely ribbed form, tending to become elongated vertically, rather than transversely. The topotype from New Zealand shows the species to be distinct from the Victorian one, which we now refer to *T. coelata*, T. Woods sp.

(?) Oligocene (Ototaran stage), Broken River, New Zealand.

striata, Hemithyris, Thomson.

Thomson, 1918, p. 11, pl. XVI., figs. 30, 31, 32, 45.

This appears to belong to the *Hemithyris bipartita* group. Thomson suggests that it is the adult form of the *Hemithyris* (*Frieleia*) *gerlachei*. It is quite distinct from the *Tegulorchynchia* type of the *nigricans* series by the fine radial ornament and lack of folding, as pointed out by Thomson. The short beak is rather striking as in that character it agrees with the *nigricans* type, excepting for the small foramen.

Recent.—Off Shackleton Glacier, Davis Sea, at 358 fathoms.

sublaevis, Hemithyris, Thomson.

Thomson, 1918, p. 117.

"Narrowly and strongly folded and possess numerous fine ribs, little imbricated, and in many specimens almost obsolete."

Miocene (Ototaran stage).—Everett's Limestone Quarry, Kakanui, Oamaru District.

tubulifera, (?) Rhynchonella, Tate.

Tate, 1899, p. 257, pl. VIII., figs. 4, 4*a*.

Tate says, "*R. tubulifera*, if juvenile, is indicative of a much less gibbous shell" (than *R. squamosa*) "in the adult stage." This, although a minute form, is apparently mature, as it shows the contour of a fully developed rhynchonellid.

Oligocene.—(?) Lower beds, Muddy Creek. Victoria.
Miocene.—Polyzoal Rock, Muddy Creek, Victoria.

A note on the European Rhynchonellid erroneously referred to the **Australian Cainozoic Fauna** as *Rhynchonella baileyana*. (See Plate I., figs. 14, 15).

References.—Tate, 1885, pl I. Id., 1886, p. 94, pl. VI., figs. 3*a-c*. Id., 1899, p. 257.

This species was recorded by Tate in 1885, as occurring at Jemmy's Point, Gippsland Lakes, and collected by Mr. J. F. Bailey.

At the time of description, Tate seemed to suspect that it was anomalous as a Tertiary species, for he remarks that it recalls some Mesozoic ones, and adds, "I do not know of any other fossil which has so depressed and broadly oval form, conjoined with marginal plications and small suberect beak as it possesses."

In 1899, Tate added a note for this species (p. 257), and said, "My surmise of its Mesozoic origin is confirmed by Mr. R. Etheridge, jnr., who attributes it to the Cretaceous of Faxoe." We have examined an extensive series of Cretaceous Rhynchonellae in the National Museum, and these, together with a comparison of Davidson's figures in his Cretaceous Memoir, proves that the above form belongs, not to a Danian rhynchonellid, but to a well-known form of the Senonian Chalk, found in England, and on the Continent. That species is *Cyclothyris limbata*, Schlotheim sp., of which the following is the principal synonymy.

Terebratulites limbatus, Schlotheim, 1813, p. 113 (Faujas, 1799, pl. XXIV., fig. 4).

Terebratula subplicata, Mantell, 1822, p. 211, pl. XXVI., fig. 5.

Rhynchonella limbata, Schlotheim sp., Davidson, 1854, p. 79, pl. XII., fig. 1-5.

We are much indebted to Professor Sir Douglas Mawson for his kindness in allowing us to see the specimen in the collection of the Adelaide Museum, and we have taken this opportunity of giving a photograph of it, as well as of a typical specimen from the Senonian of Ciply, Belgium (Nat. Mus. Coll.).

III.—Description of Tegulorhynchia, sp. nov. Genotype "Rhynchonella squamosa," Hutton.

(a).—Definition.

Ventrally uniplicate, generally wider than high; shell moderately stout; typically with a strong undulate and tegulate ornament, cor-

responding to growth-lines which cross the ribs that are typically constant on valves. By structural specialisation the tegulation becomes tubular, and eventually links up with that seen in *Tegulorhynchia doederleini*. Beak hypothyrid; as seen in edge view erect, usually truncate or only slightly incurved. Deltidial plates strong and tpyically equilaterally triangular. Dental plates well defined and strong, the septum represented on inside of dorsal valve, by a very thin plate which extends to nearly one half of the length of the shell. Muscle areas on interior of the dorsal valve are well marked and sub-quadrate, and fairly large.

(b).—Distinctions from *Hemithyris*.

According to Professor Schuchert, *Hemithyris* is defined as "smooth or faintly plicate rhynchonellae with a high ventral beak and open delthyrium. No dental plates." As a matter of fact, dental plates are present in the genotype *Hemithyris psittacea*, Chemnitz sp., the typical northern form, as indicated by Davidson, Dall and Thomson (see pl. I., fig. 13; pl. II., figs. 16, 19).

So far as we have seen, these dental plates are always slender and not well developed. On the contrary, the forms of the southern *R. nigricans* series are stout and strong compared with the northern *Hemithyris*. The type of *Hemithyris*, d'Orbigny (*Rhynchonella psittacea*) has[8] a "beak sharply pointed and incurved." *R. squamosa* has it erect and more often quite blunt.

In regard to the ornament, *Hemithyris* is typically smooth, or striate, never distinctly costate, so far as we have seen from the specimens in the National Museum collection, which were dredged from the North Sea. In these example, also, the growth-lines are purely concentric and never tend to become strongly undulose or overlapping to the extent of even a form like the living *nigricans*. In *Hemithyris* the septum is rudimentary, low, and barely extending halfway across the shell. In *Tegulorhynchia* the septum is more strongly developed, and extends into the anterior half of the shell. The deltidial plates in a typical *Hemithyris psittacea* are elongated in the form of a scalene triangle, whereas in *Tegulorhynchia* they are almost, to quite, equilateral. These plates are strongly discrete in *H. psittacea*, whereas in *Tegulorhynchia* they may be only slightly so (*T. coelata*), or conjunct (*T. squamosa*).

(c).—Phylogeny of the Genus.

From the widely spread occurrence of the Tertiary rhynchonellids of the *squamosa* type in the southern hemisphere, it is only natural to conclude that these forms sprang from some already well established ancestor in the Mesozoic.

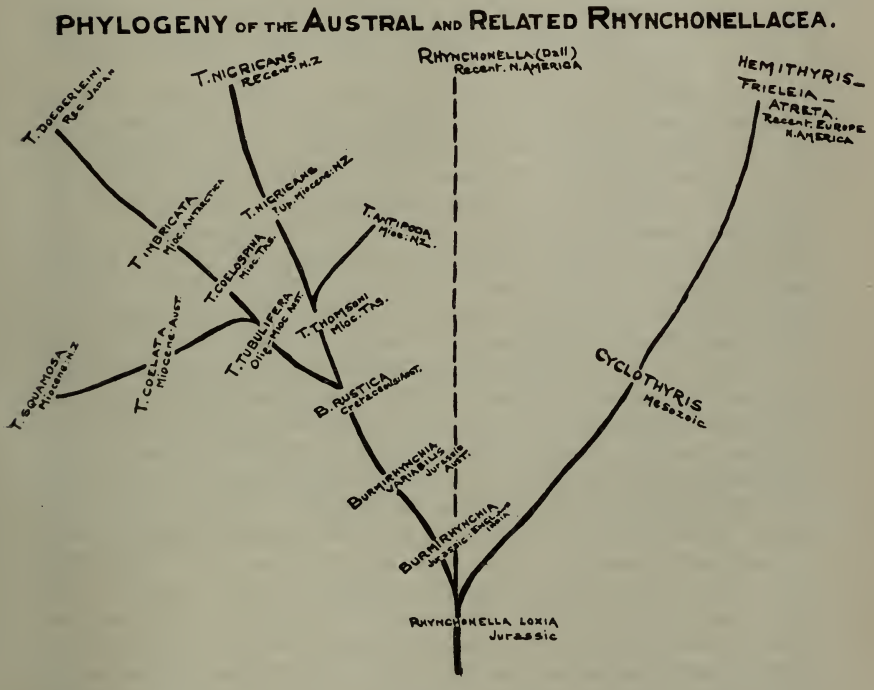
Of the recorded Mesozoic species found in Australia we have:—

Rhynchonella croydonensis, Etheridge, fil., 892, p. 560, pl. XLI., figs. 13, 14.

8. Davidson, 1887, p. 164.

In this the shell is transversely elongate, the dental plates are short, strong and somewhat curved. The lateral areas have six prominent angular ribs; the median sulcus carries four fainter costae. There are traces of distinct transverse lamellae. We are inclined to think that the two figures represent different species, since the ventral valve (fig. 13) has the deep sulcus and prominent beak of Buckman's genus *Kallirhynchia.* Figure 14, if shown by additional specimens to be distinct, might be re-named *Burmirhynchia etheridgei.*

Occurrence.—Cretaceous. Croydon Goldfields, Queensland.



Rhynchonella eyrei, Etheridge, fil., 1902, p. 8, pl. I., fig. 2.

Triangular; costae prominent and coarse, three to four on fold; two to three on the sinus, and three to four on either side. The valves are crossed by numerous, concentric frilled laminae.

Occurrence.—Lower Cretaceous. Central South Australia.

Rhynchonella rustica, Moore, 1870, p. 245, pl. X., fig. 79.

The shell is wider than long, with 20 to 25 costae. The beak is acute and compressed when young. The sur-

face is covered with striae, 20 to 25 in number, which in the adult stage are wavy and irregular.

Occurrence.—Lower Cretaceous. Queensland.

Rhynchonella solitaria, Moore, 1870, p. 245, pl. X., fig. 10.

The shell is wider than longer, with four widely spreading costae, and a single lateral costae on either side of the sinus. Costae evanescent towards the umbo.

Occurence.—Lower Cretaceous. Queensland.

Also Jurassic, Geraldton (cf. *solitaria*,—fide F. C. in Nat. Mus. coll.).

Rhynchonella variabilis, Schlotheim, Moore, 1870, p. 231-232 (list), pl. X., figs. 11, 12.

Shell as high as broad, about 9 costae, which are plicated towards the anterior commissure.

Occurrence.—Jurassic. Geraldton District, W. Australia.

With regard to these Mesozoic Australian rhynchonellids it is interesting to note that one of the forms from the Lower Cretaceous, viz., *R. rustica*, agrees with the general form of the Miocene and later *Tegulorhynchiae*. The shell is wider than long, though the transverse character is not absolutely uniform, but predominant. The numerous costae also form another factor for comparison, although the riblets in the later Tertiary and living forms tend to become less numerous and less acute. The beak in *Rhynchonella rustica* is said to be acute and compressed when young. In his description of *R. rustica*, Moore compares the Australian Cretaceous form with *R. concinna* of the Great Oolite and Bradford clay of England which, he says, "it approaches more closely." From the excellent figures of *R. concinna* given by Davidson[9], it will be seen that the delthyrium is almost exactly comparable with that in *Tegulorhynchia*, for the deltidial plates are disjunct and are almost equiangular, and in no way could *R. rustica* on this evidence be compared with the Cretaceous genus *Cyclothyris*. *R. rustica* may also be compared with the compressed and almost truncated beak in *Tegulorhynchia*. Two other forms, both from the Cretaceous of Central South Australia and Queensland respectively, are *Rhynchonella eyrei* and *R. croydonensis*. Both of these have the ornament characterised by the prominent growth-lines which cross the riblets. In *R. eyrei* these are developed into distinct laminae, and in *R. croydonensis* they also occur, but are less distinct, and more distantly placed.

In "*Rhynchonella*" *variabilis* we have a type of shell which is coarsely plicate, but the entire form of the shell is closely comparable with the variants of *Tegulorhynchia squamosa*, as we have them represented at Waurn Ponds and Keilor. The dorsal valve in these forms, is strongly ventricose, and the ventral valve is subplanate. In regard to the beak in *R. variabilis*, this is not prominent, and the apex varies from being slightly incurved to almost truncate. This seems to suggest the possibility, when compared with the other

9. Davidson, 1852, pl. xvii., figs. 6-12.

forms of beaks in Mesozoic rhynchonellids, that there is a direct relationship in this part of the structure with the Tertiary forms. The foramen also in "*R. variabilis* is distinctly hypothyrid and sub-elliptical, and the deltidial plates, though small, are very similar in shape to those of *Tegulorhynchia*. "*R.*" *variabilis* has the conjunct type of deltidial plates, whereas in the form of *Tegulorhynchia* they are almost invariably disjunct (exception, *T. Squamosa*).

(d).—Variation in Time.

The majority of the Jurassic and Cretaceous forms in Australia (*R. rustica, eyrei, croydoncnsis*-pars, *solitaria* and *variabilis*) agree in their main characters with Buckman's *Burmirhynchia*. His definition, taking *Burmirhynchia gutta*, nov. as type is[10]—"hypothyrid (beak massive, springing from a gibbous umbo, apex produced and incurving [foramen sub-elliptical, deltidial plates narrow, disjunct]); slightly trilobed; multiplicate; dental plates strong, much divergent; ventral muscle area large, pyriform; dorsal septum strong; dorsal muscle area quadriform to subcircular pattern, the two anterior scars strongly marked, making a cordate figure, being individually more or less pyriform, bounded by well-marked, diverging channels."

In these early forms the dorsal septum is strong. The later, Tertiary and living representatives, have a low dorsal septum, but extended, probably pointing to an ancestral feature of greater development. The dorsal muscle areas agree in shape both in the Indian and Australian Jurassic, and also in the Australian Tertiary types, though in the latter they are of greater extent.

In some of the earlier Mesozoic forms the beak has already been modified by truncation; that is to say, less incurved and prominent. The deltidial plates are disjunct, both in *Burmirhynchia* and *Kallirhynchia*, and these show features ancestral to the austral form, but common to both. The tegulate character is seen developing in the early forms to some extent, but not until the Miocene is it well pronounced.

(e).—Palaeographical Factors.

The *Burmirhynchia* type of shell was already established in the Lias, Inferior Oolite and Greater Oolite of England, and the Continent. It appears to have migrated along a possible shore-line in Upper Jurassic times, judging from the community of Upper Jurassic types of mollusca and brachiopoda seen in the Western Australian beds, where foraminiferal species are also common to both areas.

During this time also, the terrestrial areas were continued, forming a favourable geographical unit from Europe across to India, and thence to Australia. Many Jurassic invertebrates of the Indian area are common to Australia. The interesting fact is here brought out, that of the later type of rhynchonellid, the genus *Cyclothyris* appears to be absent thus far, and our Australian Cretaceous species

10. Buckman, 1917, p. 49.

are of the Jurassic type, which eventually passed into the type, *Tegulorhynchia*—"*nigricans* series"—of the Cainozoic and recent deposits of Australia, New Zealand, Patagonia and Antarctica.

(f).—Evidence of Bathymetrical Habitat.

The majority of the living brachiopods are, as Schuchert has already pointed out[11], deep water and abyssal, and they are practically all thin-shelled.

The present habitat of the living *Tegulorhynchia nigricans* gives a good idea of the probable average depth of the earlier tegulate forms, having a similarly thick shell. It has been recorded 5 miles east of Ruapuke Island in 19 fathoms, on rock and coral; also from Chatham Island. The range given by Canon Norman for the boreal *Hemithyris psittacea* is 10-690 fathoms, at Shetland and near the Dogger Bank. Reeve gives the range from low water to 100 fathoms.

In regard to the living form, *T. doederleini*, this was dredged in about 160 fathoms.

Fischer, in his Manual[12] separates the zone of Brachiopods and Corals, as occurring from 72 to 500 metres in depth (36-250 fathoms). He quotes Macandrew, who dredged *Hemithyris psittacea* from near Finmark, at a depth of 121 to 165 fathoms, in sand.

The group of the genus *Tegulorhynchia*, now discussed, is, generally speaking, thick-shelled. Moreover these forms are associated with shore-loving forms, as at Keilor, near Melbourne, and Table Cape, Tasmania; or in fairly deep water limestones, as at Batesford, near Geelong. In the former case the shells are typically incrassate, whereas in the deeper water habitat they are slightly thiner in build. Instances of the genus in still deeper habitat are found at Fishing Point, Cape Otway, and in the Lower Muddy creek beds.

IV.—Description of the Species of Tegulorhynchia.

1.—Tegulorhynchia squamosa, Hutton, sp.

(Pl. I., figs. 1, 2; pl. II., fig. 22; pl. III., fig. 26.)

Rhynchonella squamosa, Hutton, 1873, p. 37.

Hemithyris squamosa, Hutton, sp., Buckman, 1910, p. 10, pl. I., fig. 13.

Hemithyris squamosa, Hutton, sp., Thomson, 1918, pp. 108 and 117.

Description.—"Shell irregular, more or less orbicular; valves inequal, the ventral flatter, and with a deep groove; dorsal valve very convex; both with find radiating scaly striae. Length, .7 mm.; breadth, 7.5 mm.; height, .5 mm."

Observations.—From a topotype which has been kindly presented to the National Museum by Dr. J. A. Thomson, we note that this

11. Schuchert, 1911, p. 226.
12. Fischer, 1887, p. 188.

species tends to be greater in length than width, although there are exceptional cases where it is slightly wider than long. The beak is much higher than in *T. coelata*, and the deltidial plates are conjunct. The plication is at once seen to be much finer in character than in the Victorian species, *T. coelata*, which in some other respects it resembles. It will be appropriate here to append a synopsis of the average number of plicae which we have counted on the ventral sinus of the principal species of the genus *Tegulorhynchia*.

Species.	Average number of plicae on sinus of ventral valve.	Range in Time.
T. patagonica, *Ihering* sp.	12 to 15	Oligocene or Miocene (Patagonia) Buenos Aires.
T. squamosa, Hutton, sp.	10	(?) Oligocene, New Zealand.
T. coelata T. Woods, sp.	8	Miocene. Victoria. South Australia and Tasmania.
T. thomsoni, sp. nov.	6	Miocene. Tasmania.
T. nigricans, Sow, sp.	4	Upper Miocene to Recent. New Zealand.

Pedicle foramen, long-ovate and well elevated above the cardinal margin, the height being occasioned by the conjunct character of the deltidial plates. The elevation of these plates in some specimens is accompanied by a low, crescentic cavity between the cardinal margins of the ventral and dorsal valves. Viewed in profile, from the anterior aspect, the tegulation in *T. squamosa* seems to be largely confined to the ribs, whereas in *T. coelata* the tegulation is continuous over the ribs and intercostal areas. The discrepant growth-lines in *T. squamosa* are not so strongly marked as in *T. coelata*, and from that we may infer that *T. squamosa* is the older type, compared with *T. coelata*, the latter connecting with *T. nigricans* in this particular character of tegulation.

Occurrence.—(?) Oligocene (Ototaran stage). Broken River, New Zealand.

Miocene. Cockburn Island, Graham Land, Antarctica.

2.—Tegulorhynchia coelata, (McCoy, MS.), T. Woods, sp.

(Pl. I., figs. 3, 4; pl. II., figs. 17, 20; pl. III., fig. 27.)

Rhynchonella coelata (McCoy, MS.), T. Woods, 1878, p. 77.

Rhynchonella squamosa (non Hutton), Tate, 1880, p. 32, pl. IX., figs. 9*a*, *b*.

Rhynchonella squamosa, Hutton, Denant and Kitson, 1903, p. 129.

Acanthothyris squamosa, Hutton sp. Chapman, 1914, p. 167, fig. 89F.

Description.—In his paper on the Tertiary Deposits of Australia, Tenison Woods gives a very brief description of the species which McCoy indicates as the typical Victorian form. Tenison Woods' description is as follows:—"Rounded trigonal, with a strong mesial fold, with many fine imbricated ribs." A note is added from McCoy "from several Miocene beds in Victoria."

Davidson remarks on the relationship of this to the recent form, *T. nigricans*, from New Zealand. "Some examples in external shape cannot be distinguished, but I have not observed on any recent *R. nigricans* such prominent and strongly marked imbricated striae. The fold and sinus seem more strongly marked on the fossil form. The ribs also seem smaller and more delicate than on real *nigricans*."[13]

Specific Characters.—Shell suborbicular, more or less transversely elongated. Ventral valve depressed with a deep sinus. Dorsal valve strongly convex, with a more or less flattened median fold. Umbo rounded, not prominent. Pedicle area truncated. Foramen ovate, not large. Deltidial plates triangular, with slightly vertical prolongation; slightly discrete. The area of the valves near the lateral commissure compressed. Average number of plicae on sinus, 8; on ventral, 36 to 40.

Dimensions.—Specimen *a.*—Length, 14 mm.; width, 17 mm.; thickness of valves, 9mm. Greatest width of delthyrium, 1.25.

Specimen *b.*—Another specimen (figured), length, 16 mm.; width, 18 mm.; thickness of valves, 8.5 mm.

Observations.—This Victorian rhynchonellid has long been held to be identical with the New Zealand species which Hutton described as *R. squamosa.* In various references made subsequently there have been allusions to the several points of difference between the Victorian and New Zealand specimens. From the very fine series placed at our disposal by Mr. F. A. Cudmore, which he collected at Table Cape, Tasmania, in addition to those which we have in the National Museum collection, and others recently collected by us from the ironstone beds of Green Gully, Keilor, we are enabled with some degree of certainty to refer the Victorian specimens of the type to the original species of Tenison Woods.

This species is found in the Tasmanian "*Crassatellites* bed" in company with our new species, *T. thomsoni*, of which the description follows immediately. In that description also will be found a synopsis of the characteristic differences between these two forms. As we have already shown, the shape and ornament, such as number of costae, separate *T. coelata* from Hutton's species *T. squamosa.*

Occurrence.—Oligocene. Muddy Creek, rare. Recorded by Tate.

Miocene.—Tasmania.—*Crassatellites* bed, Table Cape. South Australia.—Aldinga (Glauconitic Limestone); Muloowurtrie, near Ardros-

13. See Woods, J. E. T., 1878, p. 77.

san; Stansbury, Yorke's Peninsula; River Bremer at Salem, near Callington. Victoria.—Aire Coast; Fishing Point, Cape Otway; Lower Moorabool; Maude; Curlewis; Flinders; Waurn Ponds; Keilor.

3.—Tegulorhynchia thomsoni, sp. nov.

(Pl. I., figs. 5, 6; pl. II., figs. 18, 21; pl. III., fig. 28.)

Description.—Shell subovate, tending to subglobose in shape, slightly wider than long. Shell stout, as in *T. coelata*.. Delthyrium is large and open. Deltidial plates strong, triangular and nearly equilateral, reminding one of similar characters in *T. nigricans*. Sinus not so deep as in *T. coelata*. Surface of valves, especially the ventral, showing interrupted growth stages. Twenty-eight plicae seen on ventral valve, six on the sinus. Beak not forwardly projecting, but truncated; deltidial plates discrete.

Dimensions.—Length, 17 mm.; width, 20.5 mm.; thickness of valve, 10:25 mm. Greatest width of delthyrium, 2.5 mm.

Observations.—This species occurs in company with *T. coelata*, T. Woods, at Table Cape, and it is interesting to note that the presence of two species was also suspected by Dr. J. Allan Thomson a few years ago. In 1914, in a letter to one of us he says: "There are two species at least at Table Cape. One appears to be *H. squamosa*, and this was probably the one called *R. coelata* by McCoy. The other is coarser ribbed and less squamose, and is also, I think, represented in New Zealand, but I would like to see a larger series of specimens before making a definite statement."

The differences between the shells of the above species and *T. coelata* are easily seen when a comparative series is laid out. These differences are as follow:—

T. thomsoni.	*T. coelata.*
Beak more prominent, approaching that of *T. nigricans*.	Beak not prominent, apex rounded in edge view, not incurved.
Plicae stouter and less numerous.	More numerous.
Six plicae on sinus.	Eight plicae on sinus.
The growth-lines not conspicuous until reaching the beginning of the ephebic stage.	Tegulation and growth-lines clearly at the beginning of the neanic stage.
Convexity more evenly distributed on both valves.	Dorsal valve tends to become extremely convex, and the fold on the sinus is more pronounced.
Lateral cardinal area evenly convex.	Compression of the lateral cardinal area pronounced.
Foramen large and rounded.	Foramen oval.
Deltidial plates equilateral; discrete, but less so than in *T. coelata*.	Deltidial plates vertically lengthened; discrete.

We have much pleasure in naming this species after Dr. Thomson, who has already done so much in regard to the description of our rhynchonellids.

Occurrence.—Miocene (Janjukian):—"*Crassatellites* bed," Table Cape, Tasmania. Type from the Dennant Collection.

4.—Tegulorhynchia antipoda, Thomson, sp.

Hemithyris antipoda, Thomson, 1918, p. 117.

Description.—The following definition is taken from Dr. Thomson's notes, as recorded above. The shell is of the same size as *nigricans* and *squamosa*. It is distinguished primarily by the character of the ribs. They are similar in size to *H. nigricans*, but are rather more numerous, and are incipiently spinous. To this we may briefly add the above species appears to be near *T. thomsoni*, but differs in the shape of the beak, and in the stronger growth-lines.

Dimensions.—Length, 20 mm.; breadth, 22 mm.; thickness, 11 mm.

Occurrence.—Miocene. Type locality, Curiosity Shop, Rakaia River, Canterbury, New Zealand.

5.—Tegulorhynchia imbricata, Buckman, sp.

Hemithyris imbricata, Buckman, 1910, p. 11, pl. I., fig. 12

Description.—(Ventral valve). "Broadly pentagonal, ornamented with numerous, somewhat stout, rounded radial, costae, which are crossed by growth-lines somewhat conspicuously; and where the crossings occur there is imbrication—the test of the rib being raised into an incipiently spinous projection. The ribs increase in number by intercalation, and by bifurcation, at irregular distances from the beak. The new rib so produced is of smaller size at first than the older ones, so that there is some irregularity of ribbing. There is a distinct mesial sinus."

Observations.—Buckman draws attention to the affinities of this species, with *T. doederleini*, Davidson, sp., the living Japanese form with hollow spines. It also shows some relationship with our new species, *T. coelospina*, described below. From the latter, *T. imbricata* differs in having finer costae, more transverse shell, and a more depressed sinus on the ventral valve.

Occurrence.—Miocene. Glauconitic Bank, Cockburn Island, off Graham Land, Antarctica.

6.—Tegulorhynchia, coelospina, sp. nov. Pl. I., fig. 7; pl. III., fig. 25.

Description.—Shell subcircular, beak fairly prominent, erect. In the type specimen, deltidial plates obscure, but seen in other examples to be triangular and strongly built; slightly discrete. Umbo of dorsal valve acute. Shell depressed, the valves showing almost equal convexity. Sinus and fold little pronounced. Plicae about four on ventral sinus. Costae about twenty-two on margin of valves. Bufurcation of the costae takes place in the later stages. The growth-

lines are developed on the costae as incipient tubular spines, somewhat developed to a market extent. The whole surface has a roughened appearance from the numerous short but prominent spines.

Dimensions.—Length, 9 mm.; width, 10 mm. Greatest thickness of valves, 4 mm.

Observations.—This Miocene form seems suggestive in its distinctly spinous characters, of a phylogenetic relationship with the living *T. doederleini*. That Buckman's suggestion that "spinosity is in itself not a generic character, it is only a stage of development to which various stocks attain" may apply in this case, but in the case of the *squamosa* type passing into *nigricans*, this principle does not seem to apply, for *squamosa* and *coelata* have a spinous tendency, but they afterwards develop into the less ornate type of *nigricans* in which the growth-lines are sometimes scarcely perceptible.

Occurrence.—Miocene. Table Cape, Tasmania.

TEGULORHYNCHIA DEPRESSA, Thomson, sp.

Hemithyris depressa, Thomson, 1918, p. 117 (see also p. 108).

Description.—(From Dr. Thomson's notes). *T. depressa* is a small species with a short beak. It is broader than *T. sublaevis*, and more depressed, and possesses numerous fine ribs, and with imbrication towards the margin.

Dimensions.—Length, 14 mm.; breadth, 16 mm.; thickness, 8 mm.

Occurrence.—(?) Oligocene and Miocene. Type locality, limestone above tuffs, one mile north of Kakanui Quarry, Oamaru district.

8.—TEGULORHYNCHIA TUBULIFERA, Tate, sp. (Pl. I., fig. 8; pl. III., figs. 23, 24.).

Rhynchonella (?) *tubulifera*, Tate, 1899, p. 257, pl. VIII., figs. 4, 4*a*.

Description.—(Of the type). "Shell tenticular, suborbicular or transversely quadrate-oval in margin outline; cardinal margin arched, anterior and posterior margins rounded, front margin nearly straight. Pedunculate valve depressed convex; beak bluntly and shortly pointed, straight, and declinous from the hinge; foramen broadly triangular, large, margined by two suberect, narrow lanceolate deltidial pieces."

"The ornament of the valves consists of round radial costae, increasing in numbers by repeated bifurcation, forty or more slightly serrating the margin; there they are a little wider than the subconcave furrows. The ribs are surmounted by stout truncated tabular spines, sufficiently close together to be almost imbricated."

"*Dimensions.* Length, 7.5 mm.; height, including beak, 6.7 mm.; thickness of valves. 2.5 mm."

Observations.—The type from which the above description was taken was referred to by Tate as unique. There is, however, an imperfect specimen in the Dennant collection in the National Museum, which is, without doubt, referable to the above species with which it agrees in main characters and ornament, and differing in the slightly

less number of costae, and in the beak being a little more prominent. We have enlisted the good services of Professor Sir Douglas Mawson in endeavouring to find the original specimen, that we might examine it, but it has not come to light. As we have gone into the matter of the identity, or otherwise, of the fragment, with Tate's type, we may note that our conclusions are in favour of the probability of there being two specimens the type evidently having been perfect. Since Tate records his type from Muddy Creek, polyzoal rock series, it is interesting to note that the Dennant specimen came also from the same bed. The differences between this form, and the previously described *T. coelospina* are in the depressed valve of the latter, and the coaser and fewer tubulated costae.

We have been favoured by Mr. Cudmore with a fragmentary valve of a rhynchonellid, presumably from the Lower beds of Muddy Creek, and this we have figured. It appears to approach most nearly *T. tubulifera*, but differs in some respects, and may point to the existence of an additional species in our series.

Occurrence.—Oligocene. (Balcombian). Lower beds, Muddy Creek. Miocene. (Janjukian). Polyzoal Rock, junction of Grange and Muddy Creek.

9.—Tegulorhynchia doederleini, Davidson, sp.

Rhynchonella doederleini, Davidson, 1886, p. 1, text-fig. 19.
Rhynchonella doederleini, Davidson, 1887, p. 172, pl. XXV., figs. 14, 15.

Description.—" Shell transversely subpentagonal, wider than long; hinge-line obtusely angular. Dorsal valve deep, posteriorly uniformly convex, anterior divided into three lobes, the central one forming a broad rounded mesial fold varying in elevation according to the age of the individual. Ventral valve much less deep than the dorsal one, with a broad mesial sinus or greater or less depth, commencing at a third of the length of the shell, and extending to the front. Beak moderately produced, almost erect, with an oval-shaped foramen situated under its gently incurved angular extremity, and margined by narrow deltidial plates. Lateral margins of the valves slightly sinuated, and forming in front a more or less elevated curve. Surface of valves marked with numerous delicate radiating ribs, with interspaces between them of almost equal width, and increasing in number at variable distances from the beaks by the interpolation of shorter riblets. Ribs numbering, in full-grown specimens, sixty, close to the margin. Valves closely crossed by numerous equidistant, concentric, raised or foliated lines of growth, giving rise at the margin of each riblet to short sloping or erect hollow spinules. Shell structure fibrous. Colour, light yellowish grey. In the interior of the dorsal valve are two short curved lamellae for the support of the labial appendages."

Dimensions.—" Length, 12 lines; breadth, 13; depth, 7 lines."

Observations.—This living species was compared in its spinosity to the Jurassic " *Rhynchonella* " *spinosa* by Davidson,[14] and was later

14. Davidson, 1886, p. 2.

referred to the Oolitic genus, *Acanthothyris*, by Schuchert.[15] It seems, however, that two distinct races, with senescent spinosity, were thus confused. Buckman[16] has remarked that *T. doederleini* is "more probably a spinous development of *Hemithyris nigricans*"; but here we may point out that, in the light of the structure of the Miocene forms, such as *T. coelospina* and *T. tubulifera*, and even of *T. imbricata*, that it is a direct descendant of the *coelospina* type rather than of the *nigricans* type.

T. doederleini has the beak and deltidial characters precisely identical with the old Miocene and even Oligocene forms, as *T. squamosa* and *T. coelata*, but the extent of development of tubuli formed out of the tegulated frilling has here resulted in long serial and regular spines. In the conjunct deltidial plates it agrees with *T. squamosa*.

Occurrence.—Dredged in 160 fathoms, in Sagami Bay, Japan.

10.—Tegulorhynchia nigricans, Sowerby, sp.

(Pl. I., figs. 9, 10, 11, 12; pl. III., figs. 29, 30.)

Rhynchonella nigricans, Sowerby, 1846, p. 91.
Rhynchonella nigricans, Suess, 1864, p. 60, pl. XIV., fig. 6.
Rhynchonella nigricans, Kirk, 1880, p. 303.
Rhynchonella nigricans, Davidson, 1887, p. 169, pl. XXIV., figs. 16-19.
Rhynchonella nigricans, Hutton, 1905, p. 480.
Hemithyris nigricans, Sow., sp., Thomson, 1915, p. 388, and p. 390, text-fig. 2*a*.

Description.—The following abbreviated description is given by Hutton.[17] "Shell thin, wider than long, but very irregular in shape; margin crenulated, commissure sinuated. Longitudinal ribs, 20 to 25 in each valve."

"*Dimensions.*—Length, 19 mm.; width, 21 mm.; thickness, 10 mm."

Observations.—This species makes its appearance in the Upper Tertiary of New Zealand (probably Upper Miocene and Pliocene), where it is represented by more massive shells than those of the recent specimens dredged around New Zealand. In the living examples the beak is usually more prominent, especially in the younger stages, and the deltidial plates are discrete. In the fossil forms the plates are more closely approximate.

Thomson considers the probability that this species "is a catagenetic development of a coarsely ribbed, imbricated, Oamaruian (probably Miocene), species are not yet named, which differs from *H. squamosa* in its much coarser ribs." This view of Thomson's is upheld by the evidence of the series now before us, *T. thomsoni* helping to connect the extremities of that series.

Occurrence.—Miocene to Recent. New Zealand.

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15. Schuchert (Zittel), 1913, p. 400.
16. Buckman, 1910, p. 11.
17. Hutton, 1905, p. 480.

11.—Tegulorhynchia pyxidata, Davidson, sp.

Rhynchonella nigricans, var. *pyxidata*, Davidson, 1880, p. 59, pl. IV., fig. 14.

Rhynchonella nigricans, var. *pyxidata*, R. B. Watson (MS.), Davidson, 1887, p. 170, pl. XXIV., fig. 20.

Hemithyris pyxidata, Davidson, sp. Thomson, 1915, p.391, footnote 4.

Description.—(From Davidson). "Shell transversely oval, widest anteriorly, tapering posteriorly, wider than long. Dorsal valve uniformly convex to about half its length, where a broad mesial fold, scarcely raised above the general convexity of the valve, occupies the anterior half of the valve. Ventral valve rather less deep and convex than the opposite one, with a broad, well-defined mesial sinus, comencing at a short distance from the extremity of the beak, and extending to the front; beak rather small, acute, and incurved; foramen incomplete, situated under its pointed extremity, laterally margined by narrow deltidial plates; surface of both valves ornamented with about forty to forty-six small, angular, radiating ribs, closely intersected by equidistant, squamose, concentric ridges of growth, giving an imbricated appearance to the surface. Colour whitish, sometimes brownish, especally at the beaks."

"*Dimensions.*—Length, 9 lines, breadth 10 lines, depth 6 lines."

Observations.—Davidson states that, "After careful study and comparison with an extensive series of New Zealand types, I am led to the conclusion that *Rhynchonella pyxidata* is merely a local variety of *R. nigricans.*" From the present standpoint, after an examination of many other variants of this series, which for convenience are given specific rank, we are inclined to regard *T. pyxidata* as distinct, on the grounds of having a more incurved beak, a less subtrigonal outline, whilst the costation is much finer and the ribs are more distinctly burfurcated towards the anterior commissure. Davidson also remarks that *T. pyxidata* "seems absolutely undistinguishable" from McCoy's "*Rhynchonella*" *coelata* from Table Cape. The Table Cape species, however, appears to have a less acute beak, which is not so strongly incurved; the shell is more elongated transversely, and the tegulation is always well developed, whereas in *T. pyxidata* the growth-lines are is an incipient stage.

In a communication recently received, Dr. Thomson strongly confirms our idea of the specific distinction of *T. pyxidata.* He also points out that the New Zealand *squamosa* has conjunct deltidial plates, whereas in *pyxidata* they are discrete.

Occurrence.—Recent. Dredged by the "Challenger," south of Kerguelen Islands, at a depth of 150 fathoms.

12.—Tegulorhynchia sublaevis, Thomson, sp.

Hemithyris sublaevis, Thomson, 1918, p. 117, see also p. 108.

Description.—A small species with a short beak, narrowly and strongly folded, with numerous fine ribs, little imbricated and in many specimens almost obsolete. (From Dr. Thomson's notes.).

Dimensions.—Length, 10 mm.; breadth, 10.5 mm.; thickness, 7 mm.

Occurrence.—(?) Oligocene. Type locality, Everett's Limestone Quarry, Kakanui, Oamaru District.

Acknowledgments.

In the preparation of this paper we desire to express our great obligations to Dr. Allan Thomson, M.A., Director of the Dominion Museum, Wellington, who has sent us on loan a most representative collection of New Zealand fossil rhynchonellids, and has presented the topotype of Hutton's *T. squamosa* to the National Museum. In addition he has taken a lively interest in our work, and we have had from him many valuable suggestions.

Our acknowledgements are also due to Mr. J. A. Kershaw, F.E.S., Curator of the National Museum, for kindly supplying us with the recent examples of *Hemithyris psittacea* and *T. nigricans*, from the zoological collections.

To Mr. F. A. Cudmore our best thanks are due for his kindness in placing in our hands the whole of his fine collection of rhynchonellids, for use in descriptive work; and for donating the specimens we have figured, to the National Museum collection.

We have also made use of a topotype of *T. squamosa* kindly sent by Mr. P. Morgan, Director of the Geological Survey of New Zealand, who has also supplied localities of New Zealand specimens in the National Museum, and to him our thanks are due.

We express our best thanks to Mr. F. A. Singleton, M.Sc., for bringing under our notice several references.

To Mr. H. Finlay we are indebted for a collection of rhynchonellids from Target Gully, New Zealand, which has been useful in our descriptive work.

V.—Summary.

1.—The austral forms of the "*nigricans* series," to which we give the new generic term, *Tegulorhynchia*, constitute a zoological group distinct from the boreal generic type, *Hemithyris*.

2.—The examination of the more spinous members of the genus *Tegulorhynchia*, including *T. coelospina* and *T. doederleini*, confirms the assumption that they have no relationship with the spinous genus, *Acanthothyris*, D'Orbigny, of Jurassic age, but are variants, not necessarily senescent, in which the tegulation is carried to an extreme in the form of redundant ornament.

3.—From an examination of the Australian Mesozoic rhynchonellid fauna, it is postulated that, the Cainozoic species of the *Tegulorhynchia* series have probably evolved from a Jurassic form like that of *Burmirhynchia*, Buckman, and without the intervention of the *Cyclothyris* type, which seems to have been entirely confined to the Cretaceous of Europe.

4.—The particular form which appears to be in the direct line of descent, and which is of Australian occurrence, is the well-known European type, "*Rhynchonella*" *variabilis*, Schlotheim, sp.

5.—The majority of form of *Tegulorhynchia* point to the fact that they were mainly inhabitants of shallow to moderately deep water, probably ranging from shore-line to several hundred fathoms.

6.—Twelve species are here arranged under the genus *Tegulorhynchia*, of which two are new, namely, *T. coelospina* and *T. thomsoni*.

7.—Our present knowledge of the distribution of the genus, both living and fossil, includes Patagonia, Brazil, Antarctica, Kerguelen Island, New Zealand, Victoria, Tasmania and South Australia.

8.—The doubtful record, as an Australian fossil, of "*Rhynchonella baileyana*" has been examined in the light of the figured specimen, and it is here definitely referred to the European species, *Cyclothyris limbata*, Schlotheim, sp.

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VII.—EXPLANATION OF PLATES.

Plate XI.

Fig. 1.—*Tegulorhynchia squamosa*, Hutton, sp. Dorsal view of the topotype. Trelissick, Basin, New Zealand. Miocene (Oamaruian). Coll. Dr. J. A. Thomson. Circ., 2 diameters.

,, 2.—*T. squamosa*, Hutton, sp. Ventral view of fig. 1. Circ., 2 diameters.

,, *T. coelata*, T. Woods, sp. Dorsal view. Waurn Ponds, near Geelong. Miocene (Janjukian). Dennant coll. Neotype, from a similar horizon to T. Woods' specimen, but from different locality. Circ., nat. size.

,, 4.—*T. coelata*, T. Woods, sp. Ventral view of fig. 3. Circ., nat. size.

,, 5.—*T. thomsoni*, sp. nov. Ventral view. Table Cape, Tasmania. Miocene (Janjukian), Crassatellites Bed. Dennant coll. Circ., nat. size.

,, 6.—*T. thomsoni*, sp. nov. Dorsal view of fig. 5. Circ., nat. size.

,, 7.—*T. coelospina*, sp. nov. Dorsal view. Table Cape, Tasmania. Miocene (Janjukian). Crassatellites Bed. Dennant coll. Circ., 2 diameters.

,, 8.—*T. tubulifera*, Tate, sp. Part of Dorsal valve. Polyzoal Limestone, junction of Grange Burn, Muddy Creek. Miocene (Janjukian). Dennant coll. Circ. 2 diameters.

,, 9.—*T. nigricans*, Sowerby, sp. Dorsal view. Trelissick Basin, New Zealand. Awamoan (Upper Miocene). Von Haast coll., Nat. Mus. Circ., nat. size.

,, 10.—*T. nigricans*, Sow., sp. Dorsal view. New Zealand. Recent. Nat. Mus. coll. Circ., nat. size.

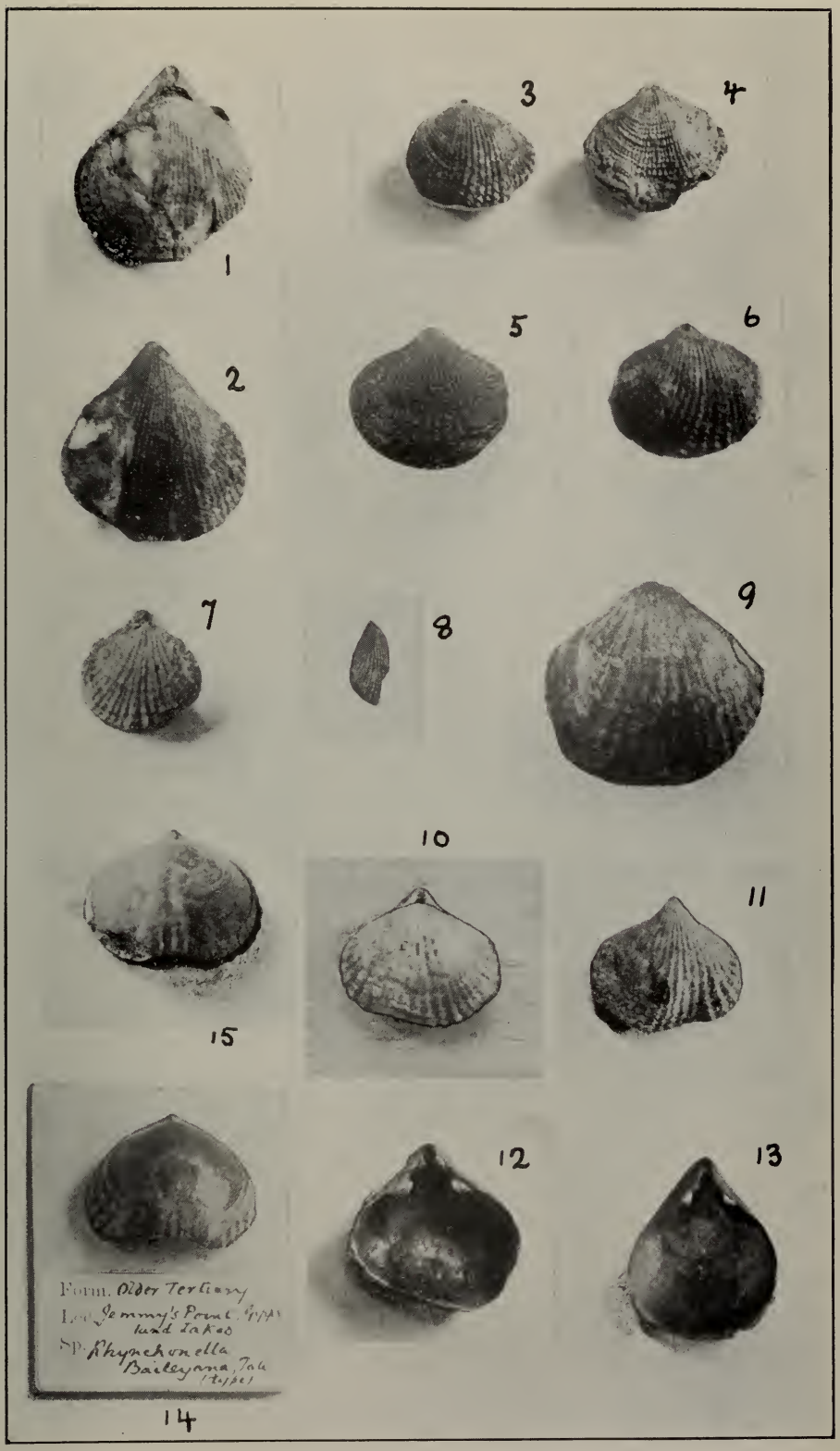
,, 11.—*T. nigricans*, Sow., sp. Ventral view of fig. 10. Circ., nat. size.

,, 12.—*T. nigricans*, Sow., sp. Internal view of ventral valve, showing dental plates. New Zealand. Recent. Nat. Mus. coll. Circ., nat. size.

,, 13.—*Hemithyris psittacea*, Chemnitz, sp. Internal view of ventral valve, showing dental plates. Northern Seas. Recent. Nat. Mus. coll. Circ., nat. size.

,, 14.—"*Rhynchonella baileyana*," Tate. Dorsal view of Tate's type specimen. The supposed fossil from Jemmy's Point, Gippsland Lakes. = *Cyclothyris limbata*, Schlotheim, sp. The figured specimen from the Adelaide Museum. Circ., nat. size.

,, 15.—*Cyclothyris limbata*, Schlotheim, sp. Dorsal view. Ciply, Belgium. Upper Cretaceous (Senonian). Nat. Mus. coll. Circ., nat. size. Typical example for comparison with Tate's *R. baileyana*.



F. C. Photo

Rhynchonellids: Cretaceous, Cainozoic and Recent